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ABSTRACT

This program quide presents the biotechnology curriculum for technical institutes in Georgia. The general information section contains the following: purpose and objectives; program description, including admissions, typical job titles, and accreditation and certification; and curriculum model, including standard curriculum sequence and lists of courses. The next three sections contain the courses: general core courses (biology I, chemistry I-II, composition and rhetoric I, college algebra, and introductory psychology); fundamental technical courses (microbiology I-II, organic chemistry I-II); and specific technical courses (biochemistry, bioseparations, biotechnology I-II, qualitative and quantitative analysis, and instrumental analysis). Each course consists of the following: a course overview (description, competency areas, prerequisites, credit hours, contact hours); course outline with student objectives and class and lab hours; and resource list. An appendix to the guide lists equipment needed for the program. (NLA)

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GEORGIA DEPARTMENT OF TECHNICAL AND ADULT EDUCATION

BIOTECHNOLOGY PROGRAM GUIDE

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BIOTECHNOLOGY PROGRAM GUIDE

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BIOTECHNOLOGY PROGRAM GUIDE

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HOW TO USE THIS MANUAL

Summary

This manual is divided into:

Tabs - major divisions, physically separated by numbered tab dividers

Sections - divisions within a tab

Subjects - divisions within a section

Numbering System

Each document (Subject) has a unique 6-digit number. This number is divided into 3 sets of 2 digits which are separated by dashes.

Example:	04	-	02	-	03
	TAB		SECTION		SUBJECT

Locating a Document

Document numbers appear on the upper right hand corner of each page (see top of this page). To locate a subject:

1. Refer to the Table of Contents.
2. Note the document number for the subject.

   Example: 04-02-03

3. Turn to the tab divider marked 04 and within this tab find Section 02 and Subject 03.

Table of Contents

The table of contents (00-00-01) is intended to give a cover-to-cover overview of the manual contents and organization. It lists contents of a Tab to the Section and Subject level.

Amendments

Registered manual holders are instructed to keep their manuals up-to-date.

Manuals Document Transmittal	All new or revised documents are sent to the registered holder of the manual and are recorded on a Manuals Document Transmittal Form. Transmittals are numbered consecutively, and instructions for use are printed on the form.
Amendment Record	The registered holder of the manual records the receipt of all manual document transmittals on the Amendment Record. This record and instructions are found on the reverse side of the manual title page.

GENERAL INFORMATION

Introduction

Overview

The Biotechnology program is consistent with the philosophy and purpose of the institution. The program provides academic foundations in communications, mathematics, natural science, and social science as well as technical fundamentals appropriate for a two-year program at the associate degree level. Program graduates are well grounded in the underlying fundamentals of biotechnology and are well prepared for employment and subsequent upward mobility.

The biotechnology technician performs those functions which support scientists in biotechnology. Technicians may work alone, or as members of a team. Important attributes for success of program graduates are critical thinking, problem solving, and the ability to apply technology to the work requirement.

The program structure acknowledges individual differences and provides opportunities for persons to seek fulfillment of their educational goals. The program does not discriminate on the basis of race, color, national origin, religion, sex, age, handicapping condition, academic disadvantage, or economic disadvantage.

To assist each student to attain his or her potential within the program, both the instructor and the student incur an obligation in the learning process. The instructor is a manager of instructional resources and organizes instruction in a manner which promotes learning. The student assumes responsibility for learning by actively participating in the learning process.

This is a dynamic field which requires extraordinary attention to current curriculum and up-to-date instructional equipment. The program promotes the concept of change as the technology evolves. The need for nurturing the spirit of involvement and lifelong learning is paramount in the biotechnology profession.

GENERAL INFORMATION

Introduction

Standard Curriculum

The Biotechnology program guide presents the standard biotechnology curriculum for technical institutes in Georgia. This curriculum addresses the minimum competencies for the Biotechnology program. The competency areas included in a local Biotechnology program may exceed what is contained in this program guide, but it must encompass the minimum competencies contained herein.

As changes occur in the Biotechnology program, this guide will be revised to reflect those changes. Proposed changes are first evaluated and approved by the local program advisory committee then forwarded to the State Technical Committee for approval and inclusion in the state standard program guide.

GENERAL INFORMATION

Introduction

Developmental Process

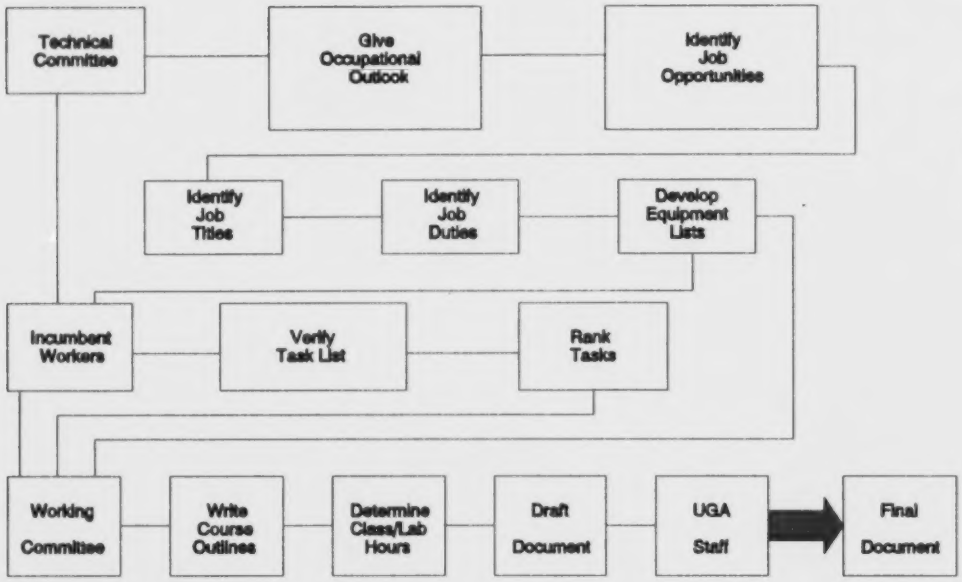
The development of the Biotechnology program guide was based on the premise that the people in the industry can best determine program needs. With this in mind, representatives from businesses which would employ program graduates were asked to serve on a State Technical Committee to help identify the technical content and to provide overall guidance to ensure that the resulting program would produce graduates qualified for entry-level positions in the profession.

The State Technical Committee verified an occupational task list that had been compiled through extensive research. These representatives included workers who had actually performed the duties and tasks being verified.

Technical institutes which would implement the curriculum were also included in the developmental effort. Representatives from the technical institutes provided the expertise in teaching methodology unique to each discipline and developed the courses contained in this program guide.

The University of Georgia coordinated and directed the development of the curriculum and produced the final program guide. The role of each group in the developmental process is shown in the diagram on the following page.

DATA/PROCESS FLOW DIAGRAM



GENERAL INFORMATION

Introduction

Purpose and Objectives

Purpose

The purpose of the Biotechnology program is to provide educational opportunities to individuals that will enable them to obtain the knowledge, skills, and attitudes necessary to succeed in the field of biotechnology.

The Biotechnology program provides educational opportunities regardless of race, color, national origin, religion, sex, age, handicapping condition, academic disadvantage, or economic disadvantage.

The Biotechnology program is intended to produce associate degree graduates who are prepared for employment in varied positions in the field of biotechnology.

Program graduates are to achieve college-level competency in the general areas of composition, technical writing, algebra, biology, chemistry, and behavioral science. Graduates are to be competent to perform basic technical functions in organic chemistry, microbiology, biochemistry, bioseparations, biotechnology, qualitative and quantitative analysis, and instrumental analysis.

Objectives

1. Provide current curriculum, instructional materials, and equipment (in accordance with available funding) which teach knowledge, skills, and attitudes appropriate to industry needs.

2. Provide educational facilities which foster learning and provide safe, healthy environments available and accessible to all students who can benefit from the program.

3. Provide collegiate-level academic instruction which supports effective learning within the program and which enhances professional performance on the job.

4. Provide employability skills which foster work attitudes and work habits that will enable graduates of the program to perform as competent and responsible employees.

5. Nurture the desire for learning so that graduates will pursue their own continuing education as a lifelong endeavor.

6. Provide an educational atmosphere which promotes a positive self-image and a sense of personal well-being.

7. Provide education that fosters development of good safety habits.

8. Provide admission, educational, and placement services without regard to race, color, national origin, religion, sex, age, handicapping condition, academic disadvantage, or economic disadvantage.

9. Provide information to the public regarding the program that will facilitate recruitment and enrollment of students.

10. Promote good public relations via contacts and regular communications with business, industry, and the public sector.

11. Promote faculty and student rapport and communications to enhance student success in the program.

GENERAL INFORMATION

Program Description

Program Defined

The Biotechnology program is a planned sequence of carefully developed college-level courses designed to prepare students to work as technicians in one of the various specialties in the field. Graduates will receive a Biotechnology associate degree. The program of study emphasizes the application of science and technology combined to prepare graduates to support scientists in various fields of biotechnology.

GENERAL INFORMATION

Program Description

Admissions

Admissions Requirements

Admission of new students to the Biotechnology associate degree program is contingent upon their meeting all of the following requirements:

a) attainment of 16 or more years of age;
b) documentation of high school graduation or satisfaction of High School Equivalency Certificate requirements;
c) achievement of minimum regular admission scores on tests of reading, language, and math as specified in GDTAE document *Minimum Program Entrance Scores;* and
d) completion of application and related procedures.

Admission of transfer students is contingent upon their meeting the following:

a) regular admission and good standing at a regionally accredited diploma or degree granting institution; and
b) proper completion of application and related procedures.

Provisional Admission

A new student who does not meet the regular admission requirements of the program may be admitted on a provisional basis. The requirements for provisional admission are:

a) attainment of 16 or more years of age;
b) documentation of high school graduation or satisfaction of High School Equivalency Certificate requirements;
c) achievement of minimum provisional admission scores on tests of reading, language, and math as specified in GDTAE document *Minimum Program Entrance Scores*; or recommendation by program faculty and designated admissions personnel on the basis of interview and assessment of student potential; and
d) completion of application and related procedures.

GENERAL INFORMATION

Program Description

Typical Job Titles

The Biotechnology program is assigned a (PGM) CIP code of (PGM) 41.0101 and is consistent with all other programs throughout the state which have the same (PGM) CIP code. The related D.O.T. job titles follow:

022.261-010	Chemical Laboratory Technician
029.261-010	Laboratory Tester
029.261-014	Pollution-Control Technician

GENERAL INFORMATION

Program Description

Accreditation and Certification

This program must conform to the institutional accreditation requirements of the Southern Association of Colleges and Schools by meeting Commission on Colleges (COC) or Commission on Occupational Education Institutions (COEI) accreditation requirements and must not conflict with the accreditation criteria established by COC and COEI.

GENERAL INFORMATION

Curriculum Model

Standard Curriculum

The curriculum design components, general core courses, fundamental occupational/technical courses, specific occupational/technical courses, and elective courses, are listed below with quarter hour credits and suggested course prerequisites and/or corequisites.

Essential Courses			Credits	Sequence
Essential General Core Courses			30	
Area I				
ENG	191	Composition and Rhetoric I	5	[P] Program admission level language competency or ENG 098
Area II				
PSY	191	Introductory Psychology	5	[P] Program admission
Area III				
BIO	191	Biology I	5	[P] Program admission
CHM	191	Chemistry I	5	[P] Program admission level math achievement
CHM	192	Chemistry II	5	[P] CHM 191
MAT	191	College Algebra	5	[P] Program admission level math achievement
Essential Fundamental Technical Courses			23	
SCT	104	Microbiology I	6	[P] CHM 191 [P/C] SCT 106
SCT	105	Microbiology II	6	[P] SCT 104
SCT	106	Organic Chemistry I	5	[P] CHM 191
SCT	107	Organic Chemistry II	6	[P] SCT 106

Essential Courses			Credits	Sequence
Essential Specific Technical Courses			45	
BIT	201	Biochemistry	5	[P] SCT 107
BIT	202	Bioseparations	6	[P] BIT 201, RLT 209
BIT	203	Biotechnology I	8	[P] SCT 105, SCT 107
BIT	204	Biotechnology II	6	[P] BIT 203
RLT	206	Qualitative and Quantitative Analysis	5	[P] CHM 192
RLT	209	Instrumental Analysis I	8	[P] RLT 206
XXX	xxx	Electives	7	
Essential Electives			10	

Program Final Exit Point

Biotechnology technician

Credits Required for Graduation

108 minimum quarter hour credits required for graduation

GENERAL INFORMATION

Curriculum Model

Standard Curriculum

The standard curriculum for the Biotechnology program is set up on the quarter system. A suggested sequence for the program is given below. Technical institutes may implement the Biotechnology program by using the sequence listed below or by using a locally developed sequence designed to reflect course prerequisites and/or corequisites.

Course	Class Hours	Lab Hours	Weekly Contact Hours	Credits
SUGGESTED SEQUENCE				
FIRST QUARTER				
BIO 191 Biology I	4	3	7	5
CHM 191 Chemistry I	4	3	7	5
MAT 191 College Algebra	5	0	5	5
XXX xxx Electives	-	-	-	5
	13	6	19	20
SECOND QUARTER				
CHM 192 Chemistry II	4	3	7	5
SCT 104 Microbiology I	4	8	12	6
SCT 106 Organic Chemistry I	4	3	7	5
	12	14	26	16

Course			Class Hours	Lab Hours	Weekly Contact Hours	Credits
THIRD QUARTER						
PSY	191	Introductory Psychology	5	0	5	5
SCT	105	Microbiology II	4	8	12	6
SCT	107	Organic Chemistry II	4	6	10	6
			13	14	27	17
FOURTH QUARTER						
BIT	203	Biotechnology I	5	9	14	8
ENG	191	Composition and Rhetoric I	5	0	5	5
RLT	206	Qualitative and Quantitative Analysis	3	6	9	5
			13	15	28	18
FIFTH QUARTER						
BIT	201	Biochemistry	5	0	5	5
BIT	204	Biotechnology II	3	9	12	6
RLT	209	Instrumental Analysis I	5	9	14	8
			13	18	31	19
SIXTH QUARTER						
BIT	202	Bioseparations	3	9	12	6
XXX	xxx	Electives	-	-	-	12
			3	9	12	18

GENERAL INFORMATION

Curriculum Model

General Core Courses

The general core courses provide students with a foundation in the basic skills which enable them to express themselves more clearly, both orally and in writing, and to perform the mathematical functions required in this occupation. The general core courses for the Biotechnology program are listed below.

BIO	191	Biology I	5 Credits
CHM	191	Chemistry I	5 Credits
CHM	192	Chemistry II	5 Credits
ENG	191	Composition and Rhetoric I	5 Credits
MAT	191	College Algebra	5 Credits
PSY	191	Introductory Psychology	5 Credits

GENERAL INFORMATION

Curriculum Model

Fundamental Technical Courses

The fundamental technical courses provide students with a foundation in the area of biotechnology which is needed to progress to the more highly specialized courses in biotechnology. The fundamental technical courses are listed below.

SCT	104	Microbiology I	6 Credits
SCT	105	Microbiology II	6 Credits
SCT	106	Organic Chemistry I	5 Credits
SCT	107	Organic Chemistry II	6 Credits

GENERAL INFORMATION

Curriculum Model

Specific Technical Courses

The specific technical courses build upon the fundamental technical courses to provide the student with the basic knowledge and skill required to work as a biotechnology technician. The specific technical courses offered in the Biotechnology program are listed below.

BIT	201	Biochemistry	5 Credits
BIT	202	Bioseparations	6 Credits
BIT	203	Biotechnology I	8 Credits
BIT	204	Biotechnology II	6 Credits
RLT	206	Qualitative and Quantitative Analysis	5 Credits
RLT	209	Instrumental Analysis I	8 Credits
		Electives	7 Credits

GENERAL INFORMATION

Curriculum Model

Electives

Elective courses are provided to allow for the different levels of prior knowledge and skills brought to the classroom by students with diverse backgrounds, educational attainment, and specialized interests.

Decisions regarding the selection and appropriateness of any elective are made by the student after consultation with the instructor. Provision must be made for electives chosen from disciplines outside the student's area of specialization.

XXX xxx Electives 10 Credits

GENERAL CORE

BIO 191 - Biology I

Course Overview

Course Description

Provides an introduction to basic biological concepts. Topics include: classification of plants and animals, cell theory, cell structure, plant and animal tissues and organs, nutritional requirements of plants and animals, energy metabolism, and use of basic biology laboratory techniques and equipment.

Competency Areas

Classification of Plants and Animals
Cell Theory
Cell Structure
Plant and Animal Tissues and Organs
Nutritional Requirements of Plants and Animals
Energy Metabolism
Use of Basic Biology Laboratory Techniques and Equipment

Prerequisite

Program admission

Credit Hours

5

Contact Hours Per Week

Class - 4

P.Lab - 3

GENERAL CORE

BIO 191 - Biology I

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Lab
CLASSIFICATION OF PLANTS AND ANIMALS		**4**	**0**
Plant and animal classification	Classify plants and animals (kingdoms through species).		
Sub-structures	Identify the sub-structures of plant and animal cells.		
Physical features	Identify the physical features of various plants and seeds.		
CELL THEORY		**8**	**3**
Organic molecules/functional groups	List the various organic molecules and functional groups important in biology.		
Cellular anatomy	Outline cellular anatomy.		
Transport and respiratory systems	Describe the transport and respiratory systems of plant cells.		
	Describe the transport and respiratory systems of animal cells.		
CELL STRUCTURE		**7**	**0**
Chromosomes	Explain the molecular basis of tree chromosomes including bacterial and viral genetics and the production of proteins.		

Recommended Outline	After completing this section, the student will:	Hours Class	Lab
Meiosis and mitosis	Discuss the processes of meiosis and mitosis.		
Diagram of cells	Diagram plant and animal cells.		
	Label plant and animal cell diagrams.		
Cell components	Describe the various components of a cell.		
PLANT AND ANIMAL TISSUES AND ORGANS		**7**	**3**
Plant anatomy	Outline the anatomy of plants.		
Transport/control systems	Summarize the transport and control systems of plants.		
Organ systems	Describe the major organ systems of vertebrates.		
Vertebrates/invertebrates	Compare and contrast form and function between vertebrates and invertebrates.		
NUTRITIONAL REQUIREMENTS OF PLANTS AND ANIMALS		**7**	**6**
Plant/animal nutritional requirements	Describe the nutritional requirements of plants and animals.		
	Compare and contrast the various nutritional requirements of plants and animals.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
ENERGY METABOLISM		**6**	**6**
Macromolecules	Describe the macromolecules involved in the metabolism of both prokaryotic and eukaryotic cells.		
Storage and utilization of energy	Explain how energy is stored and utilized by cells.		
USE OF BASIC BIOLOGY LABORATORY TECHNIQUES AND EQUIPMENT		**1**	**12**
Safety procedures	Recognize safety procedures in a biological laboratory.		
	Adhere to safety procedures in a biological laboratory.		
Scientific notebook	Record data in a scientific notebook.		
Laboratory report	Prepare a laboratory report.		
pH meter and autoclave	Use the pH meter and the autoclave.		
Microscope use	Measure microscopic organisms (animals and plants) using stage and ocular micrometers.		
	Prepare microscopic slides for the light microscope.		
	Dissect an invertebrate organism.		

GENERAL CORE

BIO 191 - Biology I

Resources

Arms, K., & Camp, P. S. (1982). *Biology*. New York: Holt, Rinehart & Winston.

Barrett, J. T. (Ed.). (1986). *Contemporary classics in the life sciences: Cell biology* (Vol. 1). Philadelphia: ISI Press.

Barrett, J. T. (Ed.). (1986). *Contemporary classics in the life sciences: The molecules of life* (Vol. 2). Philadelphia: ISI Press.

Campbell, N. A. (1990). *Biology* (2nd ed.). Reading, MA: Addison-Wesley.

Curtis, H., & Barnes, N. S. (1981). *Invitation to biology* (3rd ed.). New York: Worth.

Dulbecoo, R. (1987). *The design of life*. New Haven: Yale University Press.

Fawcett, D. W. (1981). *The cell*. Philadelphia: W. B. Saunders.

Leonard, W. H. (1989). *Laboratory investigations in biology* (2nd ed.). Minneapolis: Burgess.

Van Norman, R. W. (1981). *Experimental biology* (2nd ed.). Englewood Cliffs, NJ: Prentice Hall.

GENERAL CORE

CHM 191 - Chemistry I

Course Overview

Course Description

Provides an introduction to basic chemical principles and concepts which explain the behavior of matter. Topics include: measurement, atomic structure, chemical bonding, physical states of matter, nomenclature, and stoichiometry.

Competency Areas

Measurement
Atomic Structure
Chemical Bonding
Physical States of Matter
Nomenclature
Stoichiometry

Prerequisite

Program admission level math achievement

Credit Hours

5

Contact Hours Per Week

Class - 4

P.Lab - 3

GENERAL CORE

CHM 191 - Chemistry I

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
MEASUREMENT		**5**	**6**
Calculations	Perform calculations involving density, specific gravity, mass, and volume measurements. Apply the conventions of exponential notation and significant figures to mathematical operations.		
Analysis	Use dimensional analysis in calculations involving conversions from one set of units to another. Perform gravimetric analysis and volumetric analysis.		
ATOMIC STRUCTURE		**5**	**3**
Theory	Describe modern atomic theory and the three fundamental particles that make up atoms. Summarize the basic ideas of quantum mechanics.		
Periodic table	Relate the electronic configuration of an atom to its position on the periodic table.		

Recommended Outline	After completing this section, the student will:	Hours Class	Lab
	Predict properties and reactivities of elements.		
CHEMICAL BONDING		**10**	**3**
Chemical bonding	Describe various types of chemical bonding.		
Theory	Outline the significance and main ideas of various bonding theories.		
PHYSICAL STATES OF MATTER		**5**	**3**
Properties of matter	Describe the general properties of gases, liquids, and solids.		
	Distinguish among the general properties of gases, liquids, and solids.		
	Discuss the types of changes matter undergoes.		
NOMENCLATURE		**5**	**0**
IUPAC nomenclature	Name inorganic compounds by the IUPAC system based on their formulas.		
	Write formulas of common inorganic compounds based on their IUPAC names.		
STOICHIOMETRY		**10**	**15**
Calculations	Perform calculations involving composition stoichiometry and reaction stoichiometry.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Classification	Classify chemical reactions as to type of reaction.		
	Write examples of each type of reaction.		
Acids and bases	Discuss the properties of acids and bases.		
Gases	Summarize the general properties of gases.		
	Use the gas law equations to describe the behavior of gases.		

GENERAL CORE

CHM 191 - Chemistry I

Resources

Bretherick, L. (Ed.). (1986). *Hazards in the chemical laboratory* (4th ed.). London: The Royal Society of Chemistry.

Davis, R. E. (1988). *Study guide to accompany general chemistry with qualitative analysis* (3rd ed.). Philadelphia: Saunders College.

Fisher Scientific Co. *Safety: Isn't it worth it? #299* [Film]. Pittsburgh: Author.

Hein, M., Best, L. R., & Pattison, S. (1988). *College chemistry: An introduction to general, organic, and biochemistry* (4th ed.). Pacific Grove, CA: Brooks/Cole.

Kanare, H. M. (1985). *Writing the laboratory notebook*. Washington, DC: American Chemical Society.

Lefèvre, M. J. (1980). *First aid manual for chemical accidents*. Stroudsburg, PA: Dowden, Hutchinson & Ross.

Loebel, A. B. (1987). *Chemical problem solving by dimensional analysis* (3rd ed.). Boston: Houghton Mifflin.

Mackison, F. W., Stricoff, R. S., Partridge, L. J., Jr., & Little, A. D., Inc. (Eds.). (1987). *Pocket guide to chemical hazards* (DHEW {NIOSH} Publication No. 78-210). Washington, DC: U.S. Government Printing Office.

Manufacturing Chemists' Association, Inc. (1954). *Guide for safety in the chemical laboratory*. Princeton, NJ: D. Van Nostrand.

Murrell, J. N., Kettle, S. F., & Tedder, J. M. (1985). *The chemical bond* (2nd ed.). New York: John Wiley & Sons.

Seese, W. S., & Daub, G. H. (1985). *Basic chemistry* (4th ed.). Englewood Cliffs, NJ: Prentice Hall.

Vogel, A. (1978). *Vogel's textbook of quantitative inorganic analysis* (4th ed.). Hartaw, England: Essex.

Weast, R. C. (Ed.). (1987). *Handbook of chemistry and physics* (68th ed.). Boca Raton, FL: CRC Press.

Whitten, K. W., Gailey, K. D., Bishop, C. B., & Bishop, M. B. (1988). *Experiments in general chemistry*. Philadelphia: Saunders College.

Whitten, K. W., Gailey, K. D., & Davis, R. E. (1988). *General chemistry with qualitative analysis* (3rd ed.). Philadelphia: Saunders College.

Whitten, K. W., Hedges, R. M., & Gailey, K. D. (1988). *Lecture outline to accompany general chemistry with qualitative analysis* (3rd ed.). Philadelphia: Saunders College.

GENERAL CORE

CHM 192 - Chemistry II

Course Overview

Course Description

Continues the exploration of basic chemical principles and concepts. Topics include: equilibrium theory, solution chemistry, acid-base theory, and nuclear chemistry.

Competency Areas

Equilibrium Theory
Solution Chemistry
Acid-Base Theory
Nuclear Chemistry

Prerequisite

CHM 191

Credit Hours

5

Contact Hours Per Week

Class - 4

P.Lab - 3

GENERAL CORE

CHM 192 - Chemistry II

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Lab
EQUILIBRIUM THEORY		**10**	**10**
Activation energy	Describe activation energy.		
Reaction rates	Summarize the various factors that affect reaction rates.		
Chemical equilibrium	Describe the concept of chemical equilibrium as a dynamic equilibrium.		
Calculations	Use the equilibrium constant expression in chemical calculations.		
SOLUTION CHEMISTRY		**10**	**10**
Interactive forces	Explain the interactive forces in solution chemistry and the significance of these forces.		
Solutions	Specify concentrations of solutions.		
	Describe the properties of solutions of electrolytes.		
Osmosis	Describe osmosis and reverse osmosis.		
	Illustrate osmosis and reverse osmosis.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
ACID-BASE THEORY		**10**	**10**
Theories	Define acid, base, and neutralization in terms of the Arrhenius theory.		
	State the Bronsted-Lowry acid-base theory.		
	Apply the Bronsted-Lowry acid-base theory.		
Equations	Write balanced molecular equations, total ionic equations, and net ionic equations for neutralization reactions of acids and bases to form salts.		
Calculations	Perform calculations for titration and neutralizations.		
	Perform calculations involving pH, pOH, and buffer solutions.		
NUCLEAR CHEMISTRY		**10**	**0**
Radioactive decay	Describe the processes involved in radioactive decay.		
	Calculate remaining activity in a radioactive sample.		

GENERAL CORE

CHM 192 - Chemistry II

Resources

Adamson, A. W. (1973). *A textbook of physical chemistry*. New York: Academic Press.

Cotton, F. A., & Wilkinson, G. (1980). *Advanced inorganic chemistry: A comprehensive text* (4th ed.). New York: John Wiley & Sons.

Davis, R. E. (1988). *Study guide to accompany general chemistry with qualitative analysis* (3rd ed.). Philadelphia: Saunders College.

Murrell, J. N., Kettle, S. F., & Tedder, J. M. (1985). *The chemical bond* (2nd ed.). New York: John Wiley & Sons.

Weast, R. C. (Ed.). (1987). *Handbook of chemistry and physics* (68th ed.). Boca Raton, FL: CRC Press.

Whitten, K. W., Gailey, K. D., Bishop, C. B., & Bishop, M. B. (1988). *Experiments in general chemistry.* Philadelphia: Saunders College.

Whitten, K. W., Gailey, K. D., & Davis, R. E. (1988). *General chemistry with qualitative analysis* (3rd ed.). Philadelphia: Saunders College.

Whitten, K. W., Hedges, R. M., & Gailey, K. D. (1988). *Lecture outline to accompany general chemistry with qualitative analysis* (3rd ed.). Philadelphia: Saunders College.

GENERAL CORE

ENG 191 - Composition and Rhetoric I

Course Overview

Course Description

Emphasizes the analysis of literature and articles about issues in the humanities and in society. Students practice various modes of writing, ranging from description to exposition to argumentation and persuasion. The course includes a review of standard grammatical and stylistic usage in proofreading and editing. An introduction to library resources lays the foundation for research. Topics include: modes of writing, revision, and research.

Competency Areas

Modes of Writing
Revision
Research

Prerequisite

Program admission level language competency or ENG 098

Credit Hours

5

Contact Hours Per Week

Class - 5

Lab - 0

GENERAL CORE

ENG 191 - Composition and Rhetoric I

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Lab
MODES OF WRITING		**35**	**0**
Description	Write descriptions drawing details from observation.		
Exposition	Read literature and articles and analyze the methods of development.		
	Write essays based on personal experiences or assigned readings.		
	Demonstrate through writing the ability to employ the various methods of development.		
REVISION		**10**	**0**
Editing	Demonstrate the ability to edit own writing to eliminate jargon, choppiness, dullness, and incoherence to produce a smooth, vivid style appropriate to the subject and the audience.		
Proofreading	Demonstrate the ability to proofread own writing to eliminate sentence structure errors, verb and pronoun errors, punctuation errors, and spelling errors.		

Recommended Outline	After completing this section, the student will:	Hours Class	Lab
RESEARCH		**5**	**0**
Steps	Identify the major steps in conducting research.		
References	Locate and use appropriate reference materials for written and oral reports.		

GENERAL CORE

ENG 191 - Composition and Rhetoric I

Resources

Casty, A., & Tighe, D. J. (1979). *Staircase to writing and reading* (3rd ed.). Englewood Cliffs, NJ: Prentice Hall.

Hodges, J. C., & Whitten, M. E. (1989). *Harbrace college handbook* (11th ed.). San Diego: Harcourt Brace Jovanovich.

Kirszner, L. G., & Mandell, S. R. (1986). *Patterns for college writing: A rhetorical reader and guide* (3rd ed.). New York: St. Martin's Press.

Lunsford, A., & Connors, R. (1989). *The St. Martin's handbook* (5th ed.). New York: St. Martin's Press.

McCuen, J. R., & Winkler, A. C. (1986). *Readings for writers* (5th ed.). San Diego: Harcourt Brace Jovanovich.

Stubbs, M., & Barnet, S. (1989). *Little, Brown reader* (5th ed.). Glenview, IL: Scott, Foresman.

Winkler, A. C., & McCuen, J. R. (1988). *Rhetoric made plain* (5th ed.). San Diego: Harcourt Brace Jovanovich.

GENERAL CORE

MAT 191 - College Algebra

Course Overview

Course Description

Emphasizes techniques of problem solving using algebraic concepts. Topics include: algebraic concepts and operations, linear and quadratic equations and functions, simultaneous equations, inequalities, exponents and powers, graphing techniques, and analytic geometry.

Competency Areas

Algebraic Concepts and Operations
Linear and Quadratic Equations and Functions
Simultaneous Equations
Inequalities
Exponents and Powers
Graphing Techniques
Analytic Geometry

Prerequisite

Program admission level math achievement

Credit Hours

5

Contact Hours Per Week

Class - 5

Lab - 0

GENERAL CORE

MAT 191 - College Algebra

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
ALGEBRAIC CONCEPTS AND OPERATIONS		**10**	**0**
Fundamental laws of algebra	Identify fundamental laws of algebra.		
Algebraic expressions	Utilize fundamental laws of algebra to simplify algebraic expressions.		
Equations and formulas	Solve algebraic equations and formulas.		
LINEAR AND QUADRATIC EQUATIONS AND FUNCTIONS		**15**	**0**
Linear equations	Solve linear equations.		
Factoring	Identify all factors of algebraic expressions.		
Fractions	Convert complex algebraic fractions to equivalent forms.		
Quadratic equations	Calculate sum, difference, product, and quotient of algebraic expressions.		
	Solve quadratic equations.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
SIMULTANEOUS EQUATIONS		**9**	**0**
Graphical solutions	Solve systems of linear equations graphically.		
Algebraic solutions	Solve systems of equations algebraically.		
Solutions by determinants	Solve systems of linear equations by using determinants.		
INEQUALITIES		**2**	**0**
Graphical solution	Solve inequalities graphically.		
Algebraic solutions	Solve inequalities algebraically.		
EXPONENTS AND POWERS		**3**	**0**
Laws of exponents	Compute the value of expressions involving exponents.		
Scientific notation	Convert numbers to scientific notation.		
GRAPHING TECHNIQUES		**6**	**0**
Cartesian coordinates	Identify points on a Cartesian plane by given coordinates.		
Graphing functions	Prepare graphs of algebraic equations.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
ANALYTIC GEOMETRY		**5**	**0**
Straight line	Mathematically define a straight line and its properties.		
Conics	Mathematically define and identify the circle, parabola, hyperbola, and ellipse.		

GENERAL CORE

MAT 191 - College Algebra

Resources

Bernice, D. D. (Latest edition). *Arithmetic and algebra* (2nd ed.). Englewood Cliffs, NJ: Prentice Hall.

Bertrand, B. S. (Latest edition). *Basic mathematics for electricity and electronics* (4th ed.). New York: McGraw-Hill.

Christopher, J. (1982). *Introductory technical mathematics.* Englewood Cliffs, NJ: Prentice Hall.

Clar, L. J., & Hart, J. A. (Latest edition). *Mathematics for the technologies.* Englewood Cliffs, NJ: Prentice Hall.

Cooke, N. M., & Adams, H. F. R. (1982). *Basic mathematics for electronics* (5th ed.). New York: McGraw-Hill.

Davis, L. (1990). *Technical mathematics with calculus* (1st ed.). Columbus, OH: Merrill.

Fleming, W., & Varberg, D. (1988). *Algebra and trigonometry* (3rd ed.). Englewood Cliffs, NJ: Prentice Hall.

Gilbert, J. (1981). *College algebra and trigonometry.* Englewood Cliffs, NJ: Prentice Hall.

Paul, R. S., & Shaevel, M. L. (Latest edition). *Essentials of technical mathematics with calculus.* Englewood Cliffs, NJ: Prentice Hall.

Radford, L. (1986). *Introduction to technical mathematics with calculus.* Boston: Brenton.

Smith, K. J. (1985). *Precalculus mathematics: A functional approach.* Pacific Grove, CA: Brooks-Cole.

Swokowski, E. W. (1981). *Fundamentals of algebra and trigonometry* (5th ed.). Boston: Prindle, Weber & Schmidt.

Washington, A. J. (1990). *Basic technical mathematics with calculus* (5th ed.). Redwood City, CA: Benjamin-Cummings.

GENERAL CORE

PSY 191 - Introductory Psychology

Course Overview

Course Description

Emphasizes the basics of psychology. Topics include: science of psychology; social environments; life stages; physiology and behavior; personality; emotions and motives; conflicts, stress, anxiety, and abnormal behavior; and perception, learning, and intelligence.

Competency Areas

Science of Psychology
Social Environments
Life Stages
Physiology and Behavior
Personality
Emotions and Motives
Conflicts, Stress, Anxiety, and Abnormal Behavior
Perception, Learning, and Intelligence

Prerequisite

Program admission

Credit Hours

5

Contact Hours Per Week

Class - 5

Lab - 0

GENERAL CORE

PSY 191 - Introductory Psychology

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
SCIENCE OF PSYCHOLOGY		**3**	**0**
Definitions	Define psychology.		
History and methods	Identify the founders of the major schools of psychology.		
Careers in psychology	Describe methods used in psychological research.		
	Identify career options in psychology.		
SOCIAL ENVIRONMENTS		**14**	**0**
Definitions	Define social psychology and attitude.		
Attitudes	Differentiate between types of conformity to social norms.		
Attribution theory	Relate attitudes, reputations, and stereotypes to person perceptions.		
Attraction	Describe factors that link attraction and liking.		
Conformity, compliance, obedience, altruism, and deindividuation	Describe how the attribution theory explains behavior and some of its errors.		

Recommended Outline	After completing this section, the student will:	Hours Class	Lab
Communications	Identify the four main factors in the communication process.		
Group processes	Differentiate between verbal and nonverbal communication.		
	Provide examples of the use of effective and ineffective communications.		
	Practice active listening and nonjudgmental paraphrasing of statements.		
	Define personal space and tell how it affects behavior.		
	List factors in group effectiveness.		
	List stages of group performance.		
LIFE STAGES		**5**	**0**
Physical development	Identify stages of growth and development throughout life span.		
Moral development	Identify theories of moral development.		
Cognitive development	Identify theories of cognitive development.		
PHYSIOLOGY AND BEHAVIOR		**2**	**0**
Nervous and endocrine systems	Describe roles of the nervous and endocrine systems on behavior.		

Recommended Outline	After completing this section, the student will:	Hours Class	Lab
Altered states of consciousness	Identify altered states of consciousness.		
PERSONALITY		**7**	**0**
Definition	Define personality.		
Theories	Match major theorists with their approaches to personality.		
Assessment	List three methods of assessing personality.		
	Differentiate between objective and projective personality tests.		
	Name and describe personality disorders and types of therapy for each.		
EMOTIONS AND MOTIVES		**4**	**0**
Definitions	Define motive and emotion.		
Needs theory	Relate needs and motives.		
Theories of emotion	List Maslow's hierarchy of needs.		
Expression of emotion	Relate motivation to study habits and career choices.		
	Give examples of verbal and nonverbal means of communicating emotions.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
CONFLICTS, STRESS, ANXIETY, AND ABNORMAL BEHAVIOR		**7**	**0**
Definitions	Define stress, anxiety, and adjustment.		
Locus of control	Define locus of control and recognize own characteristics as internal or external locus of control.		
Types of conflict	Identify the major types of conflict.		
Effects of stress	Relate conflict to pressure and frustration.		
Coping mechanisms	Identify three stages of stress and physiological changes in each.		
Abnormal behavior	Identify direct and defensive coping mechanisms.		
	Name four criteria for labeling behaviors abnormal.		
	Name disorders that result from stress or anxiety and treatments for them.		
PERCEPTION, LEARNING, AND INTELLIGENCE		**8**	**0**
Definitions	Differentiate between sensation and perception.		
Classical conditioning	Identify perceptual constancies.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Operant conditioning	Identify observer characteristics in perception.		
Memory	List examples of distance, depth, and movement perceptions and of visual illusions.		
Cognition	Define learning.		
Theories of learning	Identify theories of learning.		
	Define latent learning, block, and insight.		
	Define memory.		
	Differentiate between short-term and long-term memory.		
	Define cognition, image, and concept.		

GENERAL CORE

PSY 191 - Introductory Psychology

Resources

Benjamin, L. T., et al. (1987). *Psychology.* New York: Macmillan.

Calhoun, J. F., & Acocella, J. R. (1989). *Psychology of adjustment and human relationships* (3rd ed.). New York: Random House.

Carver, C., & Scheier, M. (1988). *Perspectives on personality.* Needham Heights, MA: Allyn & Bacon.

Dworetzky, J. P. (1988). *Psychology* (3rd ed.). St. Paul: West.

Morris, C. (1990). *Psychology: An introduction* (7th ed.). Englewood Cliffs, NJ: Prentice Hall.

Scarr, S., & Zanden, J. V. (1987). *Understanding psychology* (5th ed.). New York: Random House.

Shaffer, D. R. (1988). *Social and personality development* (2nd ed.). Pacific Grove, CA: Brooks-Cole.

Spear, P. D., et al. (1988). *Psychology: Perspectives on behavior.* New York: John Wiley & Sons.

Stanovich, K. E. (1989). *How to think straight about psychology* (2nd ed.). Glenview, IL: Scott, Foresman.

Verderber, K. S., & Verderber, R. F. (1989). *Interact: Using interpersonal communication skills* (5th ed.). Belmont, CA: Wadsworth.

FUNDAMENTAL TECHNICAL

SCT 104 - Microbiology I

Course Overview

Course Description

Provides a foundation in the basic principles and laboratory techniques of microbiology. Emphasis is placed on the characteristics of different microorganisms and on safe laboratory procedures including the use and care of the compound light microscope, methods of media preparation, staining, and bacterial growth and enumeration. Topics include: the scope and history of microbiology; characterization, classification, and identification of microorganisms; morphology and fine structure of bacteria; gram negative and gram positive bacteria; reproduction and growth of bacteria; bacterial enzymes and metabolism in diagnostic tests; use of compound light microscopes; media preparation; isolation, characterization, and cultivation techniques; anaerobic microorganism cultivation; and laboratory safety.

Competency Areas

Scope and History of Microbiology
Characterization, Classification, and Identification of Microorganisms
Morphology and Fine Structure of Bacteria
Gram Negative and Gram Positive Bacteria
Reproduction and Growth of Bacteria
Bacterial Enzymes and Metabolism in Diagnostic Tests
Use of Compound Light Microscopes
Media Preparation
Isolation, Characterization, and Cultivation Techniques
Anaerobic Microorganism Cultivation
Laboratory Safety

Prerequisite

CHM 191

Prerequisite/Corequisite

SCT 106

Credit Hours

6

Contact Hours Per Week

Class - 4

P.Lab - 8

FUNDAMENTAL TECHNICAL

SCT 104 - Microbiology I

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
SCOPE AND HISTORY OF MICROBIOLOGY		**6**	**0**
Scope and history	Describe the scope and history of microbiology.		
CHARACTERIZATION, CLASSIFICATION, AND IDENTIFICATION OF MICROORGANISMS		**4**	**10**
Characterization	Explain characterization of organisms.		
Classification	Classify organisms.		
Staining techniques	Execute various staining techniques in order to study the morphology of microorganisms.		
	Use staining techniques to classify specific organisms.		
Identification	Identify common microorganisms from their chemical and physical properties.		
MORPHOLOGY AND FINE STRUCTURE OF BACTERIA		**6**	**10**
Morphology	Summarize the morphology of bacteria.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Fine structure	Explain the fine structure of bacteria.		
GRAM NEGATIVE AND GRAM POSITIVE BACTERIA		**2**	**8**
Bacteria	Identify common gram negative and gram positive bacteria.		
Properties and morphology	Describe bacteria with unusual properties and complex morphology.		
REPRODUCTION AND GROWTH OF BACTERIA		**5**	**8**
Reproduction	Explain the reproduction of bacteria.		
Growth	Describe bacteria growth.		
Cultivation	Cultivate specific microorganisms in various media.		
	Determine the exact number of microorganisms in a culture medium by both direct and indirect methods.		
BACTERIAL ENZYMES AND METABOLISM IN DIAGNOSTIC TESTS		**6**	**8**
Bacterial enzymes	Explain the nature of bacterial enzymes including chemical and physical properties.		
Identification of bacteria	Identify specific microorganisms by cultivating them on selective and differential media.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
	Determine which intracellular and extracellular enzymes microorganisms possess.		
	Determine which carbohydrates microorganisms utilize and their reaction in various biochemical media.		
	Employ the Snyder test to determine dental caries susceptibility.		
	Utilize specialized media, such as blood agar and staphylococcus 110 media, to isolate medically important bacteria.		
	Isolate some of the most frequently encountered pathogenic bacteria.		
	Characterize some of the most frequently encountered pathogenic bacteria.		
USE OF COMPOUND LIGHT MICROSCOPES		**0**	**8**
Operation	Operate a compound light microscope.		
Maintenance	Maintain a compound light microscope.		
MEDIA PREPARATION		**5**	**8**
Bacteria	Prepare bacterial media.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
ISOLATION, CHARACTERIZATION, AND CULTIVATION TECHNIQUES		**2**	**8**
Isolation of microorganisms	Isolate microorganisms in an aseptic manner.		
Characterization of microorganisms	Characterize microorganisms in an aseptic manner.		
Cultivation of microorganisms	Cultivate microorganisms in an aseptic manner.		
	Explain the different conditions (chemical and physical) which affect the growth of microorganisms.		
ANAEROBIC MICROORGANISM CULTIVATION		**3**	**8**
Cultivation	Cultivate anaerobic microorganisms in various media.		
	Explain the different conditions (chemical and physical) which affect the growth of anaerobic microorganisms.		
LABORATORY SAFETY		**1**	**4**
Safety procedures	Recognize safety procedures in a microbiological laboratory.		
	Adhere to safety procedures in a microbiological laboratory.		
	Record data in a scientific notebook.		
	Prepare a laboratory report.		

FUNDAMENTAL TECHNICAL

SCT 104 - Microbiology I

Resources

Atlas, R. M., Brown, A. E., Dobra, K. W., & Miller, L. (1984). *Experimental microbiology: Fundamentals and applications.* New York: Macmillan.

Barnes, R. S. K. (Ed.). (1984). *A synoptic classification of living organisms.* London: Blackwell Scientific.

Barrett, J. T. (Ed.). (1986). *Contemporary classics in the life sciences: Cell biology* (Vol. 1). Philadelphia: ISI Press.

Barrett, J. T. (Ed.). (1986). *Contemporary classics in the life sciences: The molecules of life* (Vol. 2). Philadelphia: ISI Press.

Buchanan, R. E., & Gibbons, N. F. (Eds.). (1974). *Bergey's manual of determinative bacteriology* (8th ed.). Baltimore: Williams & Wilkins.

Cano, R. J., & Colomé, J. S. (1986). *Microbiology.* St. Paul: West.

Cappuccino, J. G., & Sherman, N. (1983). *Microbiology: A laboratory manual.* Reading, MA: Addison-Wesley.

Difco Laboratories. (1984). *Difco manual: Dehydrated culture media and reagents for microbiology* (10th ed.). Detroit: Author.

Fawcett, D. W. (1981). *The cell.* Philadelphia: W. B. Saunders.

Gilstrap, M., Kleyn, J., & Nester, E. W. (1982). *Microbiology experiments: A health science perspective.* Philadelphia: Saunders College.

Hewitt, W., & Vincent, S. (1989). *Theory and application of microbiological assay.* San Diego: Academic Press.

Jensen, J. B. (Ed.). (1983). *In vitro cultivation of protozoan parasites.* Boca Raton, FL: CRC Press.

Jones, R. M. (1966). *Basic microscopic technics*. Chicago: University of Chicago Press.

Kavanagh, F. (1963). *Analytical microbiology*. New York: Academic Press.

Kerr, T. J. (1990). *Applications in general microbiology* (4th ed.). Salem, NC: Hunter Texts.

Kirsop, B. E., & Snell, J. J. S. (Eds.). (1984). *Maintenance of microorganisms: A manual of laboratory methods.* Orlando: Academic Press.

Krieg, N. R., & Holt, J. G. (Eds.). (1984). *Bergey's manual of systematic bacteriology* (Vol. 1). Baltimore: Williams & Wilkins.

Laskin, A. I., & Lechevalier, H. A. (Eds.). (1977). *CRC handbook of microbiology bacteria* (Vol. 1). (2nd ed.). Boca Raton, FL: CRC Press.

Miller, B. M. (Ed.). (1986). *Laboratory safety: Principles and practices*. Washington, DC: American Society for Microbiology.

Nurse, P., & Streiblová, E. (Eds.). (1984). *The microbial cell cycle.* Boca Raton, FL: CRC Press.

O'Leary, W. (Ed.). (1989). *Practical handbook of microbiology*. Boca Raton, FL: CRC Press.

Pelczar, M. J., Jr., Chan, E. C. S., & Krieg, N. R. (1986). *Microbiology* (5th ed.). New York: McGraw-Hill.

Primrose, S. B., & Wardlaw, A. C. (1982). *Sourcebook of experiments for the teaching of microbiology*. Orlando: Academic Press.

Scaife, J., Leach, D., & Galizzi, A. (1985). *Genetics of bacteria*. Orlando, FL: Academic Press.

Sneath, P. H. A., Mair, N. S., Sharpe, M. E., & Holt, J. G. (Eds.). (1986). *Bergey's manual of systematic bacteriology* (Vol. 2). Baltimore: Williams & Wilkins.

Windholz, M., Budavari, S., Blumetti, R. F., & Oherbein, E. S. (Eds.). (1983). *The Merck index* (10th ed.). Rahway, NJ: Merck.

FUNDAMENTAL TECHNICAL

SCT 105 - Microbiology II

Course Overview

Course Description

Continues the study of basic microbiology and introduces the application of techniques concerned with physiology, growth, nutrition, and genetics of microorganism species. Topics include: antibiotics and chemotherapeutic agents, physical and chemical control of microorganisms, microorganisms other than bacteria, microbial interrelationships and populations, water sanitary analysis, and microorganisms significant in medicine.

Competency Areas

Antibiotics and Chemotherapeutic Agents
Physical and Chemical Control of Microorganisms
Microorganisms Other Than Bacteria
Microbial Interrelationships and Populations
Water Sanitary Analysis
Microorganisms Significant in Medicine

Prerequisite

SCT 104

Credit Hours

6

Contact Hours Per Week

Class - 4

P.Lab - 8

FUNDAMENTAL TECHNICAL

SCT 105 - Microbiology II

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
ANTIBIOTICS AND CHEMOTHERAPEUTIC AGENTS		**6**	**12**
Effects of antibiotics and chemotherapeutic agents	Discuss the methods by which various antibiotics and chemotherapeutic agents affect microorganisms.		
	Isolate organisms resistant to antibiotics using the gradient plate technique.		
Cultivation and identification of antibiotic producing microorganisms	Determine antibiotic sensitivity of selected organisms using the Kirby-Bauer technique.		
	Isolate antibiotic producing Streptomyces from soil.		
PHYSICAL AND CHEMICAL CONTROL OF MICROORGANISMS		**6**	**12**
Effects of physical factors used in controlling microorganisms	Determine the phenol coefficient of various disinfectants.		
	Study the rate of death of bacterial cultures exposed to UV light.		
Effects of chemical methods to control microorganisms	Determine the effects of various disinfectants and antiseptics on microorganisms.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Role of disinfection and sterilization in laboratory situations	Discuss practical applications of various disinfection and sterilization procedures.		
	Evaluate sterility testing procedures.		
MICROORGANISMS OTHER THAN BACTERIA		**5**	**12**
Structure and function of bacterial viruses	Isolate phage from sewage.		
	Perform phage assay.		
Structure and function of animal and plant viruses	Discuss cultivation of animal viruses.		
Structure of fungi	Perform culture and microscopic exam of various fungi.		
Role of fungi in industry	Production of wine.		
	Production of yogurt.		
MICROBIAL INTERRELATIONSHIPS AND POPULATIONS		**7**	**12**
Interrelationships of microorganisms	Discuss commensalism, synergism and antagonism.		
Mineral cycles	Isolate nitrogen fixing bacteria from the soil.		
Carbon cycle	Isolate sulfate reducing bacteria from mud.		
Selective cultivation	Estimate the number of bacteria in soil.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
	Discuss selective cultivation techniques.		
WATER SANITARY ANALYSIS		**6**	**12**
Coliforms	Most probable number of coliform analysis of water.		
Fecal coliforms	Perform membrane filter analysis of water.		
Wastewater treatment	Noncoliform indicators of water quality.		
	Discuss wastewater treatment.		
MICROORGANISMS SIGNIFICANT IN MEDICINE		**10**	**20**
Epidemiology	Identify some bacteria significant in medicine.		
Pathogenic viruses	Discuss significant viral pathogens.		
	Discuss viral cultivation.		
Pathogenic bacteria	Culture flora of the throat.		
	Culture flora of the skin.		
Diagnosis of infectious disease	Discuss serological identification.		
	Perform serological identification of bacteria.		
Treatment of infectious disease	Discuss antimicrobial strategy.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
	Isolate some of the most frequently encountered pathogenic bacteria.		

FUNDAMENTAL TECHNICAL

SCT 105 - Microbiology II

Resources

Atlas, R. M., Brown, A. E., Dobra, K. W., & Miller, L. (1984). *Experimental microbiology: Fundamentals and applications.* New York: Macmillan.

American Publishing Health Association. (1981). *Standard methods for the examination of water and waste water* (15th ed.). Washington, DC: Author.

Barnes, R. S. K. (Ed.). (1984). *A synoptic classification of living organisms.* London: Blackwell Scientific.

Barrett, J. T. (Ed.). (1986). *Contemporary classics in the life sciences: Cell biology* (Vol. 1). Philadelphia: ISI Press.

Barrett, J. T. (Ed.). (1986). *Contemporary classics in the life sciences: The molecules of life* (Vol. 2). Philadelphia: ISI Press.

Buchanan, R. E., & Gibbons, N. F. (Eds.). (1974). *Bergey's manual of determinative bacteriology* (8th ed.). Baltimore: Williams & Wilkins.

Calleja, G. B. (1984). *Microbial aggregation*. Boca Raton, FL: CRC Press.

Cano, R. J., & Colomé, J. S. (1986). *Microbiology.* St. Paul: West.

Cappuccino, J. G., & Sherman, N. (1983). *Microbiology: A laboratory manual.* Reading, MA: Addison-Wesley.

Difco Laboratories. (1984). *Difco manual: Dehydrated culture media and reagents for microbiology* (10th ed.). Detroit: Author.

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Easmon, C. S. F., & Adlam, C. (Eds.). (1983). *Staphylococci and staphylococcal infections: Clinical and epidemiological aspects* (Vol. 1). New York: Academic Press.

Easmon, C. S. F., & Adlam, C. (Eds.). (1983). *Staphylococci and staphylococcal infections: The organism in vivo and in vitro* (Vol. 2). New York: Academic Press.

Fawcett, D. W. (1981). *The cell.* Philadelphia: W. B. Saunders.

Fuerst, R. (1978). *Frobisher and Fuerst's microbiology in health and disease* (4th ed.). Philadelphia: W. B. Saunders.

Gilstrap, M., Kleyn, J., & Nester, E. W. (1982). *Microbiology experiments: A health science perspective.* Philadelphia: Saunders College.

Jensen, J. B. (Ed.). (1983). *In vitro cultivation of protozoan parasites.* Boca Raton, FL: CRC Press.

Kavanagh, F. (1963). *Analytical microbiology.* New York: Academic Press.

Kerr, T. J. (1990). *Applications in general microbiology* (4th ed.). Salem, NC: Hunter Texts.

Miller, B. M. (Ed.). (1986). *Laboratory safety: Principles and practices.* Washington, DC: American Society for Microbiology.

Nurse, P., & Streiblová, E. (Eds.). (1984). *The microbial cell cycle.* Boca Raton, FL: CRC Press.

O'Leary, W. (Ed.). (1989). *Practical handbook of microbiology.* Boca Raton, FL: CRC Press.

Pelczar, M. J., Jr., Chan, E. C. S., & Krieg, N. R. (1986). *Microbiology* (5th ed.). New York: McGraw-Hill.

Primrose, S. B., & Wardlaw, A. C. (1982). *Sourcebook of experiments for the teaching of microbiology.* Orlando: Academic Press.

Scaife, J., Leach, D., & Galizzi, A. (1985). *Genetics of bacteria.* Orlando, FL: Academic Press.

Scimone, J. (1978). *Laboratory manual of clinical bacteriology.* Westport, CT: AVI.

Sneath, P. H. A., Mair, N. S., Sharpe, M. E., & Holt, J. G. (Eds.). (1986). *Bergey's manual of systematic bacteriology* (Vol. 2). Baltimore: Williams & Wilkins.

Windholz, M., Budavari, S., Blumetti, R. F., & Oherbein, E. S. (Eds.). (1983). *The Merck index* (10th ed.). Rahway, NJ: Merck.

FUNDAMENTAL TECHNICAL

SCT 106 - Organic Chemistry I

Course Overview

Course Description

Introduces organic chemistry and the role of hydrocarbons and their products. Topics include: functional groups and structural formulas of organic compounds, IUPAC nomenclature, common nomenclature, properties of organic compounds, nomenclature of functional groups, safety procedures for organic laboratories, separation and purification of organic compounds, structural formulas of functional groups, and hazardous waste disposal. Laboratory experiences stress techniques of preparation, isolation, and purification of organic compounds.

Competency Areas

Functional Groups and Structural Formulas of Organic Compounds
IUPAC Nomenclature
Common Nomenclature
Properties of Organic Compounds
Nomenclature of Functional Groups
Safety Procedures for Organic Laboratories
Separation and Purification of Organic Compounds
Structural Formulas of Functional Groups
Hazardous Waste Disposal

Prerequisite

CHM 191

Credit Hours

5

Contact Hours Per Week

Class - 4

P.Lab - 3

FUNDAMENTAL TECHNICAL

SCT 106 - Organic Chemistry I

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
FUNCTIONAL GROUPS AND STRUCTURAL FORMULAS OF ORGANIC COMPOUNDS		**5**	**0**
Functional group	Identify the functional group present in an organic compound from its structural formula.		
Structural formulas	Draw the structural formulas of isomers.		
IUPAC NOMENCLATURE		**10**	**0**
Nomenclature	Write the IUPAC of alkanes, alkenes, alkynes, and aromatic hydrocarbons from their structural formulas.		
Structural formulas	Draw the structural formulas of alkanes, alkenes, alkynes, and aromatic hydrocarbons from their IUPAC.		
COMMON NOMENCLATURE		**8**	**0**
Nomenclature	Write the common names of alkanes, alkenes, alkynes, and aromatic hydrocarbons from their structural formulas.		

Recommended Outline	After completing this section, the student will:	Hours Class	Lab
Structural formulas	Draw the structural formulas of alkanes, alkenes, alkynes, and aromatic hydrocarbons from their common names.		
PROPERTIES OF ORGANIC COMPOUNDS		**2**	**3**
Physical properties	Describe the physical properties of the classes of organic compounds.		
NOMENCLATURE OF FUNCTIONAL GROUPS		**8**	**0**
Nomenclature	Write IUPAC and common names of halides, alcohols, ethers, aldehydes, ketones, carboxylic acids, and amines from their structural formulas.		
SAFETY PROCEDURES FOR ORGANIC LABORATORIES		**1**	**3**
Hazards	Describe the special hazards present in an organic laboratory.		
Equipment and apparel	List safety equipment and apparel used in an organic laboratory.		
SEPARATION AND PURIFICATION OF ORGANIC COMPOUNDS		**0**	**23**
Recrystallization	Recrystallize organic compounds from a single solvent and mixed solvents.		
Fractional distillation	Separate organic liquids using simple fractional distillation.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Extraction	Use a separatory funnel for the extraction of organic compounds.		
Chromatography	Use the techniques of thin layer chromatography and column chromatography for the separation of mixtures.		
STRUCTURAL FORMULAS OF FUNCTIONAL GROUPS		**5**	**0**
Structural formulas	Draw condensed structural formulas of halides, alcohols, ethers, aldehydes, ketones, carboxylic acids, and amines from their common and IUPAC names.		
HAZARDOUS WASTE DISPOSAL		**1**	**1**
Procedures	Explain the proper disposal procedures for the various classes of organic compounds.		

FUNDAMENTAL TECHNICAL

SCT 106 - Organic Chemistry I

Resources

Brown, W. H., & McClarin, J. A. (1981). *Introduction to organic and biochemistry* (3rd ed.). Boston: Willard Grant Press.

Burgoyne, E. E. (1979). *A short course in organic chemistry*. New York: McGraw-Hill.

Ege, S. N. (1984). *Organic chemistry*. Lexington, MA: Heath.

Hart, H. (1982). *Laboratory manual organic chemistry: A short course* (7th ed.). Boston: Houghton Mifflin.

Hart, H. (1982). *Organic chemistry: A short course* (7th ed.). Boston: Houghton Mifflin.

Loudon, G. M. (1988). *Organic chemistry*. Menlo Park, CA: Benjamin-Cummings.

Mackison, F. W., Stricoff, R. S., Partridge, L. J., Jr., & Little, A. D., Inc. (Eds.). (1978). *Pocket guide to chemical hazards* (DHEW {NIOSH} Publications No. 78-210). Washington, DC: U.S. Government Printing Office.

Manufacturing Chemists' Association, Inc. (1954). *Guide for safety in the chemical laboratory*. Princeton, NJ: D. Van Nostrand.

Moore, J. A., & Dalrymple, D. L. (1976). *Experimental methods in organic chemistry* (2nd ed.). Philadelphia: W. B. Saunders.

Morrison, R. T., & Boyd, R. N. (1973). *Organic chemistry* (3rd ed.). Boston: Allyn & Bacon.

Solomons, T. W. G. (1984). *Organic chemistry* (3rd ed.). New York: John Wiley & Sons.

Vogel, A. (1987). *Vogel's textbook of practical organic chemistry, including qualitative organic analysis* (4th ed.). London: Longman Group Limited.

Weast, R. C. (Ed.). (1987). *Handbook of chemistry and physics* (68th ed.). Boca Raton, FL: CRC Press.

FUNDAMENTAL TECHNICAL

SCT 107 - Organic Chemistry II

Course Overview

Course Description

Continues the study of organic chemistry with emphasis on reactions of functional groups. Laboratories will provide in-depth experiences in synthesis, isolation, and purification techniques for organic compounds. Topics include: diagnostic testing of functional groups, products of functional group reactions, synthesis and purification of functional groups, stereochemistry, chromatography and spectroscopy, organic reactions, and organic synthesis.

Competency Areas

Diagnostic Testing of Functional Groups
Products of Functional Group Reactions
Synthesis and Purification of Functional Groups
Stereochemistry
Chromatography and Spectroscopy
Organic Reactions
Organic Synthesis

Prerequisite

SCT 106

Credit Hours

6

Contact Hours Per Week

Class - 4

P.Lab - 6

FUNDAMENTAL TECHNICAL

SCT 107 - Organic Chemistry II

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
DIAGNOSTIC TESTING OF FUNCTIONAL GROUPS		**2**	**30**
Diagnostic tests	Prepare an unsaturated hydrocarbon.		
	Perform diagnostic tests on unsaturated hydrocarbons.		
	Perform diagnostic tests on alcohols, phenols, and organic halide.		
	Perform diagnostic tests on ethers, aldehydes, ketones, carboxylic acids, amines, and carbohydrates.		
PRODUCTS OF FUNCTIONAL GROUP REACTIONS		**15**	**6**
Unsaturated hydrocarbon	Prepare an unsaturated hydrocarbon.		
	Perform diagnostic tests on unsaturated hydrocarbons.		
	Prepare aromatic hydrocarbon substitution products.		
Products of common reactions	Draw the products of common reactions of halides, alcohols, ethers, aldehydes, ketones, carboxylic acids, and amines.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
SYNTHESIS AND PURIFICATION OF FUNCTIONAL GROUPS		**1**	**9**
Synthesis	Synthesize examples of ethers, halides, and alcohols.		
Purification	Purify examples of ethers, halides, and alcohols.		
STEREOCHEMISTRY		**5**	**3**
Conversion	Convert one stereoisomer to another using molecular models.		
	Convert one stereoisomer to another using a chemical reaction.		
CHROMATOGRAPHY AND SPECTROSCOPY		**1**	**6**
Separation	Use column chromatography to separate a two component mixture.		
Spectroscopy	Explain the utility of spectroscopy in the identification of organic compounds.		
ORGANIC REACTIONS		**10**	**6**
Common reactions	Predict the products of common reactions of alkanes, alkenes, alkynes, aromatic hydrocarbons, halides, alcohols, and ethers from their IUPAC and common names.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
	Explain the importance and function of halides, alcohols, ethers, aldehydes, ketones, carboxylic acids, amines, carbohydrates, and proteins.		
ORGANIC SYNTHESIS		**6**	**0**
Chemical reactions	Write chemical reactions for the preparation of alkanes, alkenes, aromatic hydrocarbons, halides, alcohols, and ethers.		

FUNDAMENTAL TECHNICAL

SCT 107 - Organic Chemistry II

Resources

Burgoyne, E. E. (1979). *A short course in organic chemistry*. New York: McGraw-Hill.

Ege, S. N. (1984). *Organic chemistry*. Lexington, MA: Heath.

Hart, H. (1982). *Laboratory manual organic chemistry: A short course* (7th ed.). Boston: Houghton Mifflin.

Hart, H. (1982). *Organic chemistry: A short course* (7th ed.). Boston: Houghton Mifflin.

Loudon, G. M. (1988). *Organic chemistry*. Menlo Park, CA: Benjamin-Cummings.

Manufacturing Chemists' Association, Inc. (1954). *Guide for safety in the chemical laboratory*. Princeton, NJ: D. Van Nostrand.

Moore, J. A., & Dalrymple, D. L. (1976). *Experimental methods in organic chemistry* (2nd ed.). Philadelphia: W. B. Saunders.

Morrison, R. T., & Boyd, R. N. (1973). *Organic chemistry* (3rd ed.). Boston: Allyn & Bacon.

Solomons, T. W. G. (1984). *Organic chemistry* (3rd ed.). New York: John Wiley & Sons.

Vogel, A. (1987). *Vogel's textbook of practical organic chemistry, including qualitative organic analysis* (4th ed.). London: Longman Group Limited.

Weast, R. C. (Ed.). (1987). *Handbook of chemistry and physics* (68th ed.). Boca Raton, FL: CRC Press.

SPECIFIC TECHNICAL

BIT 201 - Biochemistry

Course Overview

Course Description

This course presents an overview of the chemistry of living systems. Included is a study of biological molecules, metabolism, and molecular genetics. Topics include: carbohydrates and lipids, amino acids and proteins, the biochemical organization of the cell, biochemical energetics, enzyme and enzyme kinetics, carbohydrate metabolism, lipid metabolism, the tricarboxylic acid cycle, electron transport and oxidative phosphorylation, photosynthesis, and biosynthesis of nucleic acids and proteins.

Competency Areas

Carbohydrates and Lipids
Amino Acids and Proteins
The Biochemical Organization of the Cell
Biochemical Energetics
Enzyme and Enzyme Kinetics
Carbohydrate Metabolism
Lipid Metabolism
The Tricarboxylic Acid Cycle
Electron Transport and Oxidative Phosphorylation
Photosynthesis
Biosynthesis of Nucleic Acids and Proteins

Prerequisite

SCT 107

Credit Hours

5

Contact Hours Per Week

Class - 5

Lab - 0

SPECIFIC TECHNICAL

BIT 201 - Biochemistry

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
CARBOHYDRATES AND LIPIDS		**5**	**0**
Carbohydrates	Classify carbohydrates based on the number of sugar units.		
	Describe the properties of monosaccharides.		
	Explain the importance and functions of polysaccharides.		
AMINO ACIDS AND PROTEINS		**5**	**0**
Amino acids	Draw structures of the essential amino acids.		
	Describe the organization and properties of peptides.		
Proteins	Classify proteins.		
	Explain the biological functions of proteins.		
	Describe various protein structures.		
THE BIOCHEMICAL ORGANIZATION OF THE CELL		**4**	**0**
Cell diagrams	Draw a diagram of a typical prokaryote and a eukaryote cell.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Cell components	Explain the function of cell components.		
	Describe the structure and function of the cell wall.		
BIOCHEMICAL ENERGETICS		**4**	**0**
Metabolic pathways	Discuss the importance of metabolic pathways.		
	Describe the differences between catabolic and anabolic metabolic pathways.		
ENZYME AND ENZYME KINETICS		**5**	**0**
Enzyme classification	Classify enzymes according to structure and function.		
Kinetics	Describe Michaelis-Menten kinetics.		
	Compare and contrast competitive and noncompetitive inhibition.		
CARBOHYDRATE METABOLISM		**5**	**0**
Glycolysis	Explain the importance and function of glycolysis.		
	Compare and contrast aerobic and anaerobic glycolysis.		
	Describe how glycolysis is regulated.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
LIPID METABOLISM		**4**	**0**
Metabolic pathways	Describe the five metabolic pathways that lipids follow.		
THE TRICARBOXYLIC ACID CYCLE		**5**	**0**
Tricarboxylic acid cycle	Summarize the tricarboxylic acid cycle. Explain the tricarboxylic acid cycle function. Describe secondary metabolic pathways for tricarboxylic acid cycle intermediates.		
ELECTRON TRANSPORT AND OXIDATIVE PHOSPHORYLATION		**5**	**0**
Oxidative phosphorylation	Describe the process of oxidative phosphorylation.		
Electron transport	Explain the importance of oxidative phosphorylation and electron transport in cell function.		
PHOTOSYNTHESIS		**4**	**0**
Photosynthesis	Write the photosynthesis equation. Describe the process of photosynthesis. List the various types of organisms which carry out photosynthesis.		

Recommended Outline	After completing this section, the student will:	Hours Class	Lab
	Compare photosynthetic phosphorylation and oxidative phosphorylation.		
BIOSYNTHESIS OF NUCLEIC ACIDS AND PROTEINS		**4**	**0**
Nucleic acids	Describe the structure and properties of nucleic acids.		
DNA	Describe the replication and transcription of DNA.		

SPECIFIC TECHNICAL

BIT 201 - Biochemistry

Resources

Fasman, G. D. (1989). *Practical handbook of biochemistry and molecular biology.* Boca Raton, FL: CRC Press.

Lehninger, A. L. (1982). *Principles of biochemistry.* New York: Worth Publishers.

McCammon, J. A., & Harvey, S. C. (1987). *Dynamics of proteins and nucleic acids.* Cambridge, England: Cambridge University Press.

SPECIFIC TECHNICAL

BIT 202 - Bioseparations

Course Overview

Course Description

This course develops expertise in the isolation and purification of biologically important molecules. Topics include: buffer preparation, protein isolation and purification, gel permeation chromatography, ion exchange chromatography, isolation of DNA, gel electrophoresis, scintillation counting, enzyme assays, and radiation safety.

Competency Areas

Buffer Preparation
Protein Isolation and Purification
Gel Permeation Chromatography
Ion Exchange Chromatography
Isolation of DNA
Gel Electrophoresis
Scintillation Counting
Enzyme Assays
Radiation Safety

Prerequisites

BIT 201, RLT 209

Credit Hours

6

Contact Hours Per Week

Class - 3

P.Lab - 9

SPECIFIC TECHNICAL

BIT 202 - Bioseparations

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
BUFFER PREPARATION		**3**	**10**
Selection	Use a buffer chart to select a buffer.		
Preparation	Determine the amount of components needed to prepare a buffer.		
	Prepare various buffers with the appropriate pH.		
Storage	Store buffers properly.		
PROTEIN ISOLATION AND PURIFICATION		**4**	**10**
Centrifugation	Use centrifugation techniques to separate cell components.		
	Isolate protein fractions.		
GEL PERMEATION CHROMATOGRAPHY		**3**	**10**
Gel permeation chromatography	Describe the process of gel permeation chromatography for protein purification.		
	Prepare gel permeation columns for protein purification.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
	Use gel permeation columns for protein purification.		
ION EXCHANGE CHROMATOGRAPHY		**3**	**10**
Ion exchange chromatography	Describe the process of ion exchange chromatography applied to the purification of proteins.		
	Prepare ion exchange columns for protein purification.		
	Use ion exchange columns for protein purification.		
ISOLATION OF DNA		**4**	**10**
DNA isolation	Discuss the various techniques used for DNA isolation.		
	Isolate DNA from several sources.		
GEL ELECTROPHORESIS		**3**	**10**
Agarose gels	Prepare agarose gels.		
Electrophoresis	Perform electrophoresis on agarose gels.		
SCINTILLATION COUNTING		**4**	**10**
Radioisotopes	Discuss the use of radioisotopes in the research laboratory.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Radioactive decay	Describe the process of radioactive decay.		
	Calculate the activity remaining in a radioactive sample.		
Scintillation	Explain the function of the components of a scintillation counter.		
	Use a scintillation counter to count radioactive samples.		
ENZYME ASSAYS		**3**	**10**
Enzyme analysis	Prepare substrate solutions for enzyme analysis.		
	Use an absorption spectrophotometer to measure the rate of an enzymatic reaction.		
	Calculate the activity of an enzyme from its rate of reaction.		
RADIATION SAFETY		**3**	**10**
Radiation	List the various types of ionizing radiation, their effects upon the body, and their shielding requirements.		
Safety program	Describe the necessary components of a complete radiation safety program.		
	Describe the appropriate methods of disposal of radioactive materials.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
	Describe the appropriate apparel and handling methods for common radioactive isotopes used in the research laboratory.		
	Perform a wipe survey.		

SPECIFIC TECHNICAL

BIT 202 - Bioseparations

Resources

Andrews, A. T. (1985). *Electrophoresis: Theory, techniques, and biochemical and clinical applications.* New York: Oxford University Press.

Bradford, M. M. (1976). A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein-dye binding. *Analytical Biochemistry, 72,* 248-254.

Grant, R. A. (Ed.). (1980). *Applied protein chemistry.* London: Applied Science Publishers LTD.

Hames, B. D., & Rickwood, D. (Eds.). (1981). *Gel electrophoresis of proteins.* Oxford, England: IRL Press Limited.

Hancock, W. S. (Ed.). (1984). *CRC handbook of HPLC for the separation of amino acids, peptides, and proteins* (Vol. I). Boca Raton, FL: CRC Press.

Hancock, W. S. (Ed.). (1984). *CRC handbook for the separation of amino acids, peptides, and proteins* (Vol. II). Boca Raton, FL: CRC Press.

Johnson, E. L., & Stevenson, R. (1978). *Basic liquid chromatography.* Palo Alto, CA: Varian Associates.

Krstulovic, A. M., & Brown, P. R. (1982). *Reversed - phase high performance liquid chromatography.* New York: John Wiley & Sons.

Lindsay, S. (1987). *High performance liquid chromatography.* New York: John Wiley & Sons.

Patterson, R. (1970). *An introduction to ion exchange.* London: Heyden & Son Ltd.

Regis Chemical Company. (1976). *A user's guide to chromatography: Gas, liquid, TCL.* Morton Grove, IL: Regis Chemical Company.

Rickwood, D., & Hames, B. D. (Eds.). (1982). *Gel electrophoresis of nucleic acids: A practical approach.* Oxford, England: IRL Press Limited.

Scopes, R. K. (1987). *Protein purification: Principles and practice* (2nd ed.). New York: Springer-Verlag.

Sigma Chemical Company. (1983). *SDS molecular weight markers* (Technical Bulletin No. MWS-877). St. Louis: Author.

Sigma Chemical Company. (1988). *SDS molecular weight markers in a discontinuous buffer* (Technical Bulletin No. MWS-877L). St. Louis: Author.

Synder, L. R., & Kirkland, J. J. (1979). *Introduction to modern liquid chromatography* (2nd ed.). New York: John Wiley & Sons.

Willett, J. E. (1987). *Gas chromatography.* New York: John Wiley & Sons.

Worthington Biochemical Corporation. (1972). *Worthington enzyme manual.* Freehold, NJ: Author.

SPECIFIC TECHNICAL

BIT 203 - Biotechnology I

Course Overview

Course Description

Explores basic procedures used in biotechnology. Emphasis will be placed on manipulation of genetic constituents to produce medically and industrially important metabolites, utilization of microorganisms in industrial processes, and cloning of plants. Topics include: isolation and characterization of DNA; principles of genetic engineering; plant tissue culture; vitamin, amino acid, ethanol, and organic acid production; microbial fermentation technology; and food fermentation.

Competency Areas

Isolation and Characterization of DNA
Principles of Genetic Engineering
Plant Tissue Culture
Vitamin, Amino Acid, Ethanol, and
Organic Acid Production
Microbial Fermentation Technology
Food Fermentation

Prerequisites

SCT 105, SCT 107

Credit Hours

8

Contact Hours Per Week

Class - 5

P.Lab - 9

SPECIFIC TECHNICAL

BIT 203 - Biotechnology I

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
ISOLATION AND CHARACTERIZATION OF DNA		**8**	**10**
DNA isolation and characterization	Identify the methods used to isolate and characterize DNA. Perform isolation and characterization of DNA.		
PRINCIPLES OF GENETIC ENGINEERING		**8**	**15**
Transfer methods	Explain the various methods by which DNA is transferred from one organism to another.		
Transduction	Perform DNA transfer by transduction.		
Transformation	Perform DNA transfer by transformation.		
Conjugation	Perform DNA transfer by conjugation.		
PLANT TISSUE CULTURE		**8**	**25**
Cloning and propagation	Describe cloning and propagation of plants. Clone various plants.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
	Propagate various plants.		
VITAMIN, AMINO ACID, ETHANOL, AND ORGANIC ACID PRODUCTION		**9**	**15**
Methods of production	Discuss methods used to produce vitamins, amino acids, ethanol, and organic acids.		
Production	Produce products such as vitamins, amino acids, ethanol, and organic acids.		
MICROBIAL FERMENTATION TECHNOLOGY		**9**	**15**
Fermentation	Explain the various methods used to produce microbial fermentation.		
FOOD FERMENTATION		**8**	**10**
Production	Produce fermented food products such as sauerkraut, cheese, yogurt, beer, wine, salami, and pepperoni.		

SPECIFIC TECHNICAL

BIT 203 - Biotechnology I

Resources

Ball, C. (Ed.). (1984). *Genetics and breeding of industrial microorganisms.* Boca Raton, FL: CRC Press.

Birge, E. A. (1988). *Bacterial and bacteriophage genetics* (2nd ed.). New York: Springer-Verlag.

Bollon, A. P. (Ed.). (1984). *Recombinant DNA products: Insulin, interferon, and growth hormone.* Boca Raton, FL: CRC Press.

Bottino, P. J. (1981). *Methods in plant tissue culture.* Kensington, MD: Kemtec Educational Corporation.

Chakrabarty, A. M. (Ed.). (1978). *Genetic engineering.* Boca Raton, FL: CRC Press.

Crueger, W., & Crueger, A. (1984). *Biotechnology: A textbook of industrial microbiology* (C. Haessly, Trans.). Madison, WI: Science Tech. (Original work published 1982)

Demain, A. L., & Solomon, N. A. (Eds.). (1986). *Manual of industrial microbiology and biotechnology.* Washington, DC: American Society for Microbiology.

Grainger, J. M., & Lynch, J. M. (1984). *Microbiological methods for environmental biotechnology.* Orlando: Academic Press.

Hanson, E. D. (Ed.). (1983). *Recombinant DNA research and the human prospect.* Washington, DC: American Chemical Society.

Kaplan, A. S. (Ed.). (1982). *Organization and replication of viral DNA.* Boca Raton, FL: CRC Press.

Laskin, A. I., & Lechevalier, H. A. (Eds.). (1984). *CRC handbook of microbiology: Microbial transformation* (Vol. VII). (2nd ed.). Boca Raton, FL: CRC Press.

Macario, A. J. L., & de Macario, E. C. (Eds.). (1985). *Monoclonal antibodies against bacteria* (Vol. I). Orlando: Academic Press.

Macario, A. J. L., & de Macario, E. C. (Eds.). (1985). *Monoclonal antibodies against bacteria* (Vol. II). Orlando: Academic Press.

Mathews, C. K., Kutter, E. M., Mosig, G., & Berget, P. B. (1983). *Bacteriophage T4.* Washington, DC: American Society for Microbiology.

McCarty, M. (1985). *The transforming principle.* New York: W. W. Norton.

Miller, J. H. (1972). *Experiments in molecular biology.* Cold Spring Harbor, NJ: Cold Spring Harbor Laboratory.

Stenesh, J. (1989). *Dictionary of biochemistry and molecular biology.* New York: John Wiley & Sons.

Williamson, R. (Ed.). (1981). *Genetic engineering 1.* Orlando, FL: Academic Press.

Williamson, R. (Ed.). (1981). *Genetic engineering 2.* Orlando, FL: Academic Press.

Williamson, R. (Ed.). (1982). *Genetic engineering 3.* Orlando, FL: Academic Press.

Williamson, R. (Ed.). (1983). *Genetic engineering 4.* Orlando, FL: Academic Press.

SPECIFIC TECHNICAL

BIT 204 - Biotechnology II

Course Overview

Course Description

Explores how to utilize organisms isolated and characterized in the basic biotechnology course to produce various pharmaceuticals (antibiotics and vitamins), organic acids, amino acids, enzymes, single-cell proteins, and synthetic fuels. Topics include: biological production, purification, and analysis of antibiotics, vitamins, organic acids, enzymes, and synthetic fuels.

Competency Areas

Biological Production, Purification, and
Analysis of Antibiotics, Vitamins, Organic
Acids, Enzymes, and Synthetic Fuels

Prerequisite

BIT 203

Credit Hours

6

Contact Hours Per Week

Class - 3

P.Lab - 9

SPECIFIC TECHNICAL

BIT 204 - Biotechnology II

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
BIOLOGICAL PRODUCTION, PURIFICATION, AND ANALYSIS OF ANTIBIOTICS, VITAMINS, ORGANIC ACIDS, ENZYMES, AND SYNTHETIC FUELS		**30**	**90**
Antibiotics	Produce antibiotics.		
	Purify antibiotics.		
	Perform a complete analysis to determine purity, contaminants, and/or trace elements.		
Vitamins	Produce vitamins.		
	Purify vitamins.		
	Perform a complete analysis to determine purity, contaminants, and trace elements.		
Organic acids	Produce organic acids.		
	Purify organic acids.		
	Perform a complete analysis to determine purity, contaminants, and trace elements.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Enzymes	Produce enzymes.		
	Purify enzymes.		
	Perform a complete analysis to determine purity, contaminants, and trace elements.		
Synthetic fuels	Produce synthetic fuels.		
	Purify synthetic fuels.		
	Perform a complete analysis to determine purity, contaminants, and trace elements.		

SPECIFIC TECHNICAL

BIT 204 - Biotechnology II

Resources

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SPECIFIC TECHNICAL

RLT 206 - Qualitative and Quantitative Analysis

Course Overview

Course Description

Develops skill in traditional wet chemical analysis and quantitative laboratory measurements and stoichiometry. Qualitative analysis emphasizes solution preparation and chemical techniques. Quantitative analysis emphasizes instrumental studies involving spectrophotometric analysis and atomic absorption spectroscopy. Topics include: pH and pOH, chemical equilibria, ionization constants and solubility products, identification of cations, spectrophotometry, and concentration determinations.

Competency Areas

pH and pOH
Chemical Equilibria
Ionization Constants and Solubility Products
Identification of Cations
Spectrophotometry
Concentration Determinations

Prerequisite

CHM 192

Credit Hours

5

Contact Hours Per Week

Class - 3

P.Lab - 6

SPECIFIC TECHNICAL

RLT 206 - Qualitative and Quantitative Analysis

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
pH AND pOH		**5**	**5**
pH and pOH solutions	Calculate pH and pOH of solutions.		
CHEMICAL EQUILIBRIA		**8**	**0**
Chemical equilibria	List factors which influence chemical equilibria.		
IONIZATION CONSTANTS AND SOLUBILITY PRODUCTS		**4**	**0**
Salt solubility	Use the solubility product principle to predict the solubility of salts in water.		
Ionization constants	Perform calculations using ionization constants.		
IDENTIFICATION OF CATIONS		**3**	**20**
Cation separation	Select procedures for separation of cations from solutions given a flow chart of group separations. Separate cations in known and unknown solutions using wet chemical techniques.		

Recommended Outline	After completing this section, the student will:	Hours Class	Lab
	Identify cations in known and unknown solutions using wet chemical techniques.		
SPECTROPHOTOMETRY		**8**	**20**
Spectrophotometer	Draw a block diagram of a manual visible spectrometer.		
	Explain the function of each component.		
	Operate a spectronic 20 visible spectrometer.		
	Obtain the visible absorption spectrum of a compound.		
	List factors which influence colormetric analysis.		
Atomic absorption spectrophotometer	Draw a block diagram of an atomic absorption spectrophotometer.		
	Explain the function of each component of an atomic absorption spectrophotometer.		
CONCENTRATION DETERMINATIONS		**2**	**15**
Concentrations	Prepare solutions.		
	Set up a standard curve to determine the concentration of an unknown.		
	Operate an atomic absorption spectrophotometer.		

SPECIFIC TECHNICAL

RLT 206 - Qualitative and Quantitative Analysis

Resources

Christian, G. D., & Feldman, F. J. (1970). *Atomic absorption spectroscopy: Applications in agriculture, biology, and medicine.* New York: Wiley-Interscience.

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SPECIFIC TECHNICAL

RLT 209 - Instrumental Analysis I

Course Overview

Course Description

Develops expertise in the use of common laboratory instruments. Instrumental methods will be used in the isolation and purification of natural products. Topics include: gas chromatography, integrators/computer work station use, liquid chromatography, ultraviolet/visible spectrophotometry, infrared spectrophotometry, gel electrophoresis, sample preparation, use of radioisotopes, mass spectrometry, nuclear magnetic resonance, and radiation safety.

Competency Areas

Gas Chromatography
Integrators/Computer Work Station Use
Liquid Chromatography
Ultraviolet/Visible Spectrophotometry
Infrared Spectrophotometry
Gel Electrophoresis
Sample Preparation
Use of Radioisotopes
Mass Spectrometry
Nuclear Magnetic Resonance
Radiation Safety

Prerequisite

RLT 206

Credit Hours

8

Contact Hours Per Week

Class - 5

P.Lab - 9

SPECIFIC TECHNICAL

RLT 209 - Instrumental Analysis I

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
GAS CHROMATOGRAPHY		**8**	**12**
Diagram	Draw a block diagram of a gas chromatograph.		
Function	Explain the function of each component of a gas chromatograph.		
Parameter selection	Explain methods for the selection of parameters used in the operation of a gas chromatograph.		
Operation	Operate a gas chromatograph.		
	Obtain a standard curve used in the determination of an unknown.		
INTEGRATORS/COMPUTER WORK STATION USE		**1**	**5**
Operation	Program a reporting integrator.		
	Operate a reporting integrator.		
	Use menu driven software to set up a chromatographic workstation.		
	Use menu driven software to collect data from actual samples.		

Recommended Outline	After completing this section, the student will:	Hours Class	Lab
	Use menu driven software to analyze data from actual samples.		
LIQUID CHROMATOGRAPHY		**8**	**12**
Liquid chromatography	List the four main types of liquid chromatography.		
	Describe the theory of operation for each type of liquid chromatography.		
Diagram	Draw a block diagram of high performance liquid chromatography.		
Function	Explain the function of each component of a high performance liquid chromatograph.		
Parameter selection	Explain methods for the selection of parameters used in the operation of a high performance liquid chromatograph.		
Operation	Operate a high performance liquid chromatograph.		
	Obtain a standard curve used in the determination of an unknown.		
ULTRAVIOLET/VISIBLE SPECTROPHOTOMETRY		**5**	**12**
Diagram	Draw a block diagram of a double beam recording UV-visible spectrophotometer.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Function	Explain the function of each component of a double beam UV-visible spectrophotometer.		
Operation	Operate a double beam UV-visible spectrophotometer to obtain the absorption spectra of various compounds.		
	Set up a standard curve for an unknown determination.		
INFRARED SPECTROPHOTOMETRY		**6**	**12**
Diagram	Draw a block diagram of an infrared spectrophotometer.		
Function	Explain the function of each component of an infrared spectrophotometer.		
Operation	Operate an infrared spectrophotometer to obtain the absorption spectra of various compounds.		
	Use proper sampling techniques for solids and liquids.		
GEL ELECTROPHORESIS		**6**	**12**
Theory	Explain the theory of operation of gel electrophoresis.		
Operation	Prepare gels.		

Recommended Outline	After completing this section, the student will:	Hours Class	Lab
	Perform gel electrophoresis on protein samples.		
SAMPLE PREPARATION		**2**	**12**
Cleanup methods	Discuss the common methods for sample cleanup stating the advantages and disadvantages of each method.		
Preparation	Prepare samples for various types of laboratory instruments.		
USE OF RADIOISOTOPES		**2**	**10**
Operation	Explain the utility of radioisotopes in scientific research.		
	Use a scintillation counter to count radioactive samples.		
	Set up a standard curve using a scintillation counter.		
MASS SPECTROMETRY		**4**	**0**
Theory	Explain the theory of operation of mass spectrometry.		
NUCLEAR MAGNETIC RESONANCE		**4**	**0**
Theory	Explain the theory of operation of nuclear magnetic resonance spectroscopy.		

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Operation	Use nuclear magnetic resonance spectra to identify some common organic compounds.		
RADIATION SAFETY		4	3
Safety procedures	Explain the safety procedures necessary while handling radioisotopes.		
Safety equipment	List safety equipment and apparel used in handling radioisotopes.		

SPECIFIC TECHNICAL

RLT 209 - Instrumental Analysis I

Resources

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APPENDIX A

APPENDIX A

Biotechnology

Equipment List

Acid cabinet
Agitator, rotary
Aspirator filter pumps
Atomic absorption spectrometer
Balance, analytical
Balance, top loading
Beakers, 10ml, 50ml, 100ml, 150ml, 250ml, 400ml, 600ml, 1000ml
Blender, explosion resistant
Bottles, reagent, assorted sizes
Brushes, flask, assorted sizes
Brushes, test tube, assorted sizes
Bunsen burners
Burets, 50ml
Cabinet, biohazard
Cabinet, laminar flow
Carboys
Carts, laboratory
Cassettes, processing/embedding
Centrifuge, benchtop
Centrifuge, refrigerated
Centrifuge, rotors
Chromatography chamber, refrigerated
Chromatography columns
Chromatography data station
Circulatoring bath, refrigerated
Clamp holders
Clamps, buret
Clamps, ring
Clamps, three-prong
Clamps, tubing
Coliform bath
Colony counter
Continuous flow centrifuge
Cork borers
Counter, hand held
Crucible tongs
Crucibles
Cryostat-microtome
Densitometer
Desiccator, vacuum
Die, KBr
Dissecting knives
Dissecting needles
Dropper bottles
Electroblotting system
Electrophoresis, horizontal cell
Electrophoresis, power supply
Electrophoresis, vertical cell
Evaporating dishes
Evaporator, vortex
Eye wash station
Fermenter
Filter, membrane, microbiological
Filters, sterilization units
Fire extinguisher, chemical
First aid kit
Flask, culture, 250ml, 500ml, 1000ml
Flask, freeze-dry, assorted sizes
Flasks, boiling, 250ml, 500ml, 1000ml
Flasks, erlenmeyer, 50ml, 125ml, 250ml, 500ml, 1000ml
Flasks, filtering, 125ml, 250ml, 500ml, 1000ml
Flasks, round bottom, assorted sizes
Flasks, volumetric, 10ml, 25ml, 50ml, 100ml, 250ml, 500ml, 1000ml, 2000ml
Flotation bath
Forceps
Fraction collector

Fume hood
Funnel, filtering, assorted sizes
Funnels, buchner, assorted sizes
Funnels, glass fritted
Funnels, separatory, 125ml, 250ml, 500ml
Gas chromatograph
Gas regulator, compressed air
Gas regulator, helium
Gas regulator, hydrogen
Gas regulator, nitrogen
GC columns
Glass rod, assorted sizes
Glass tubing, assorted sizes
Glassware kits, organic microscale
Graduated cylinders, 10ml, 25ml, 50ml, 100ml, 500ml, 1000ml
Heating mantles
High performance liquid chromatograph
Homogenizer, tissue
HPLC columns
HPLC sample filter holders
Hydraulic press
Ice bucket
Ice crusher
Ice maker
Incubator, carbon dioxide
Incubator, dry heat
Incubator, walk-in
Infrared liquid cells
Infrared spectrometer
Inoculating loops
Integrator, automatic
Isoelectric focusing cell
Lab/lift supports
Lamp, ultraviolet
Lyophilizer
Magnetic stir bars, assorted sizes
Magnetic stirrer/hot plate
Masks, particle
Melting point/boiling point apparatus
Micro-centrifuge
Microliter syringes
Microscope, phase contrast
Microscopes
Microtomes
Millipore filtration apparatus
Mortar and pestle, agate
Mortar and pestle, porcelain, assorted sizes
Needle probes
Oven, drying
Oven, microwave
Petri dishes
pH electrodes
pH meter
Pinch clamps
Pipet bulbs
Pipets, volumetric, 1ml, 2ml, 3ml, 4ml, 5ml, 6ml, 7ml, 8ml, 9ml, 10ml
Pipettors, micro, assorted sizes
Pipettors, tips
Pump, peristaltic
Refrigerator, explosion proof
Respirator for organic vapors
Rings, cork
Rings stands
Rolling lab ladder
Rotary evaporation system
Rubber policemen
Safety shower
Scintillation counter
Scintillation vials
Scissors
Sepprep extraction columns
Shaker, orbital
Slide boxes
Slide covers
Slide stainer
Slide staining dishes
Slide warmer
Slides, microscope
Solvent pumps

Sonicator
Spatulas, assorted sizes
Spatulas, micro
Spatulas, semimicro
Spectronic 20
Sterilizer, autoclave
Sterilizer, bacti-cinerator
Stir bar extractor
Stoppers, rubber, assorted sizes
Stopwatch
Syringe, needles, assorted sizes
Syringes, assorted sizes
Test tube racks, assorted sizes
Thermometer, general laboratory
Timers
Tissue embedding center
Tissue processor histomatic
TLC chambers
TLC plates
Tubes, culture, assorted sizes
Tubes, test, assorted sizes
Turntable
Ultracentrifuge
Ultracentrifuge, fixed angle rotor
Ultracentrifuge, titanium rotor
Ultralow temperature freezer
UV quartz cells, assorted sizes
UV-visible spectrophotometer
Vacuum infiltrator assembly
Vacuum pump
Voltage regulator
Vortex mixer
Wash bottles
Washer, glassware
Watch glasses, assorted sizes
Water bath
Water bath, shaking
Water system, deionized

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